

WHAT IS CLAIMED IS:

1. A magnetization control method, comprising:
  - providing at least one metal probe;
  - 5 providing a substrate;
  - providing on the substrate a multilayer film including a first ferromagnetic metallic layer, a non-magnetic metallic middle layer, and a second ferromagnetic metallic layer located facing said metal
  - 10 probe;
  - maintaining the distance between said metal probe and said multilayer film as substantially constant so as not to contact said multilayer film;
  - providing an electric field between said metal probe
  - 15 and said multilayer film; and
  - controlling the electric field to change at least one direction of magnetization of said ferromagnetic metallic layers.
- 20 2. The magnetization control method according to Claim 1, further comprising providing an anti-ferromagnetic layer between the first ferromagnetic layer and the substrate.
3. An information recording apparatus, comprising:
  - 25 at least one metal probe,

a multilayer film including a first ferromagnetic metallic layer, a middle non-magnetic metallic layer, and a second ferromagnetic metallic layer facing said metal probe,

5            wherein the probe is structured so that a distance between said metal probe and said multilayer film is maintained substantially constant so as not to contact said multilayer film and an electric field between said metal probe and said multilayer film is controlled to change at  
10   least one direction of magnetization of said ferromagnetic metallic layers for recording information corresponding to said electric field.

4. An information recording apparatus, comprising:

15            at least one metal probe,  
             a multilayer film comprising a ferromagnetic metallic layer, a middle non-magnetic metallic layer, and a ferromagnetic metallic layer for facing said metal probe;

20            wherein said metal probe is structured so that a distance between said metal probe and said multilayer film is maintained substantially constant so as not to contact said multilayer film;

             a controller wherein an electric field between  
25   said metal probe and said multilayer film is

controlled to change at least one direction of magnetization of said ferromagnetic metallic layers for recording information corresponding to said electric field;

5                   and wherein said metal probe is structured so that between said metal probe and said multilayer film, there is an applied voltage for flowing tunnel current through to read information recorded by a change in said tunnel current corresponding to a  
10                   change in a direction of magnetization due to said electric field which corresponds to said information.

5. The information recording apparatus according to Claim 4, wherein said multilayer film is formed as a disk-shaped  
15   recording medium for rotation;

                  said metal probe is provided to oppose said multilayer film at a tip end of an arm, one end of which is rotatably supported and the other end side of which is extended to said disk-shaped recording medium;

20                   and at the tip end of said arm, there is further provided a slider; whereby a distance between said metal probe and said multilayer film is maintained substantially constant by said slider so the metal probe will not contact said multilayer film;

wherein said metal probe is structured so that an electric field between said metal probe and said multilayer film is controlled to change at least one direction of magnetization of said ferromagnetic metallic layer for  
5 recording information corresponding to said electric field;

and wherein said metal probe is structured so that between said metal probe and said multilayer film, there is applied a voltage for flowing tunnel current through to read information recorded by a change in said tunnel current  
10 corresponding to a change in a direction of magnetization due to an electric field which corresponds to said information.

6. The information recording apparatus according to Claim  
15 5, wherein in place of said tunnel current, information recorded by a provided GMR element or a TMR element located at the tip end of said arm is read.

7. The information recording apparatus according to Claim  
20 4, further comprising:

a plurality of metal probes arranged at predetermined intervals in place of said at least one metal probe,

a multilayer film including a ferromagnetic metallic layer, a middle non-magnetic metallic layer, and a  
25 ferromagnetic metallic layer for facing said plurality of

metal probes, wherein a distance between said metal probes and said multilayer film is maintained substantially constant;

wherein an electric field between said metal probes  
5 and said multilayer film is controlled to change at least one direction of magnetization of said ferromagnetic metallic layer for recording information corresponding to said electric field every one of said plurality of metal probes and;

10 wherein said metal probes are structured so that between said metal probes and said multilayer film, there is an applied voltage for flowing tunnel current through to read information recorded by a change in said tunnel current corresponding to a change in a direction of magnetization  
15 due to an electric field which corresponds to said information from every one of said plurality of metal probes.

8. The information recording apparatus according to claim  
20 3, wherein the ferromagnetic metallic layer of said multilayer film which faces said metal probe is made into domains which have been spatially divided in units of information to be recorded.

9. The information recording apparatus according to Claim 3, further comprising providing an anti-ferromagnetic layer between the first ferromagnetic layer and the substrate.